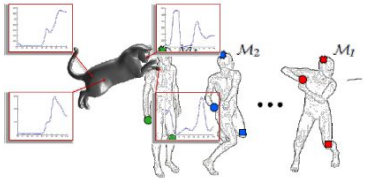
Computer Vision & Artificial Intelligence

IN2106 Practical Course:
Shape Reconstruction and Matching in Computer Vision

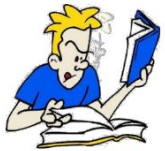
Preparation Meeting, 08.02.2023
start at 14:00.
00.08.059

Mohammed Brahimi, Simon Weber, Maolin Gao

Structure



Lecture Part:
lectures in the initial weeks with programming assignments



Project Part:
working on a research project in group
Regular meetings with supervisors

Outcome:
give a talk and write a scientific report

Followed by Q&A (no further exams)

Lectures

- Masters practical course (prerequisites see later)
- 3-4 video lectures with face-to-face Q&A
  Wednesdays, 14:00-15:30 (starting from 19.04.2023 on)
- Programming assignments
- Topics: shape operators, distances, shape matching, reconstruction, manifolds
- Data modalities: images, point clouds, set, graphs etc.

Goal: You will know the necessary theories and background knowledges to start your projects.

Projects

- Research oriented projects
- Dynamic research goals
- Projects assignments to be done after the lecture part
- Working on a research project in group of max. 2 persons
- Regular 1-on-1 meeting with supervisors for updates and resolving issues [offline/online]
- Computation resources via ssh
- Weekly written summary of the progress before your 1-on-1 meeting

- Projects specifics will be decided later
- However, you can submit project proposals before the new semester and it may be considered (sample projects see later)

Evaluation Criteria

A weighted combination of:

- Homework assignments
- Project code and results
- Weekly and final reports
- Presentation and Q&A

Prerequisites

- Proficiency in python (or matlab)
- Familiar with version control (git)
- Comfortable with DL frameworks (pytorch, pyg etc.)
- Good knowledge of basic mathematics, linear algebra, probability, numerics, analysis etc.
- Participation in at least one of the offered deep learning lectures/labs, eg. I2DL,ADL4CV,IN2349 …
- Or participation in at least one of the Multi-View Geometry lectures/labs, eg. MVG,VISNAV, IN2293 …

- We may consider other courses offered outside of TUM if the content matches. Please highlight them in your application.

Application

- Assignment to the course via the matching system: https://matching.in.tum.de.
  (select your preference of the lab course on the system.)
- Application documents to be sent separately to us:
  Send your CV and Transcripts by 22.02.2023 to srmcv-ss23@vision.in.tum.de
  Please see the email format on the next slide
- We only consider the candidates who applied to the matching system AND sent their application documents

Application Email Format

In order to easily evaluate your profile for matching, we ask you to follow the format below:

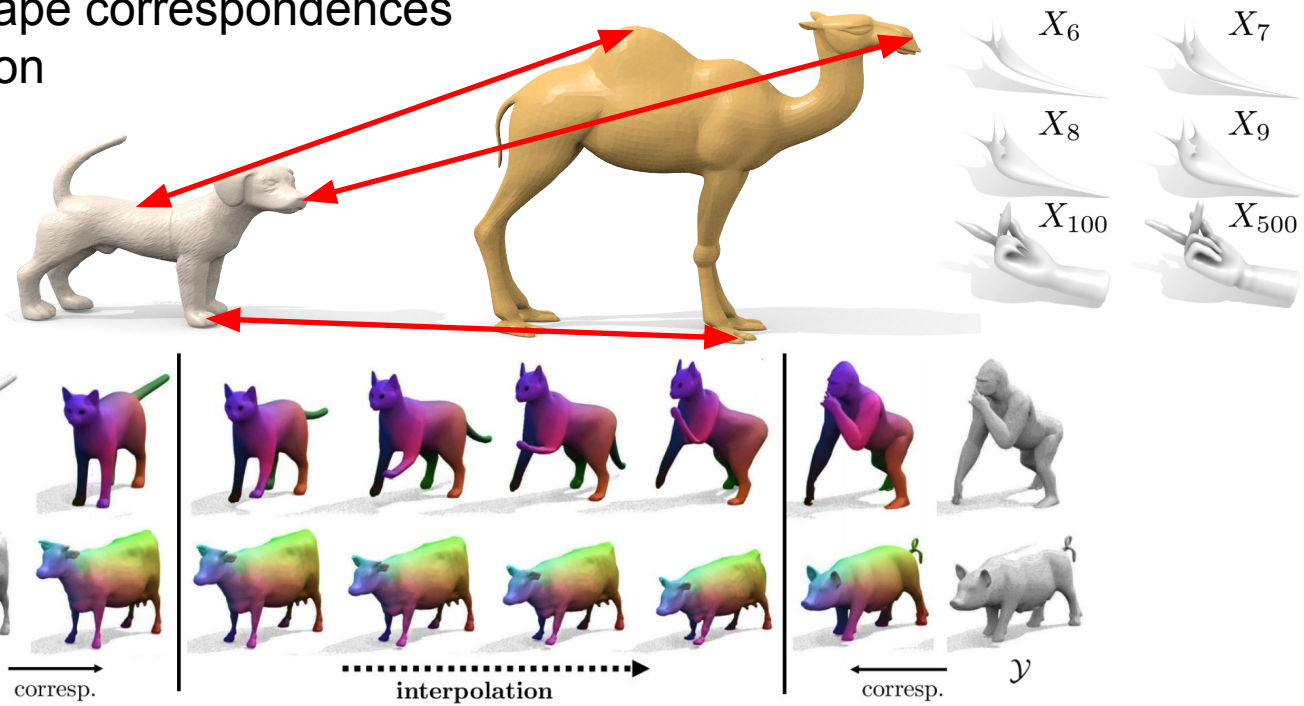
Subject: Application [Your Matriculation Number]
In the body please give at least the following details:

- *Matriculation #:*
- *Name:*
- *Name of Degree:*
- *Masters Semester #:*
- *Average Grade:*
  - *Bachelor:*
  - *Master (For the previous semester, if available)*
- *List of Relevant courses taken with grade*

Please remember to also attach your CV and transcripts(Bachelor + Master).
Feel free to share any additional documents, information (eg. link to git, past research projects) that could support your application.
Optional: If you also have a project proposal fit into the lab course, please briefly describe.

Projects Samples

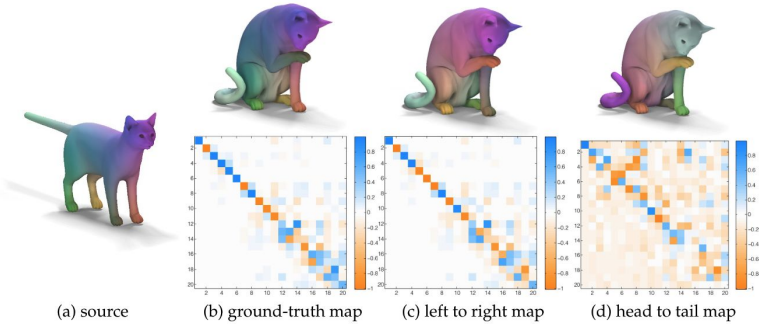
- Non-isometric shape correspondences
- Shape interpolation

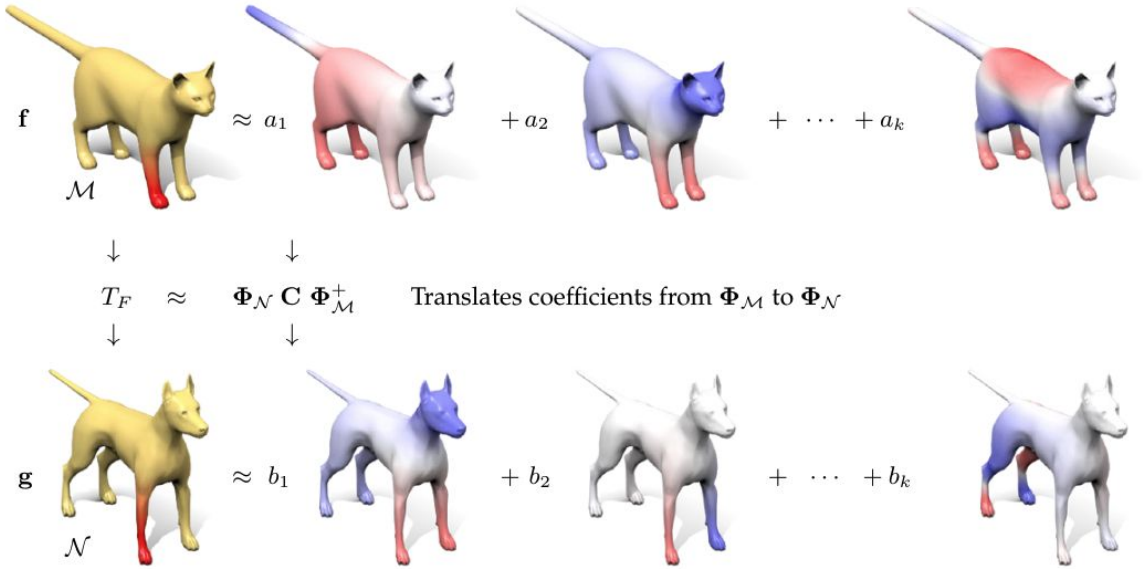


Eisenberger et al. Smooth Shells, https://arxiv.org/abs/1905.12512
NeuroMorph https://arxiv.org/abs/2106.09431

Projects Samples

- Functional Correspondences

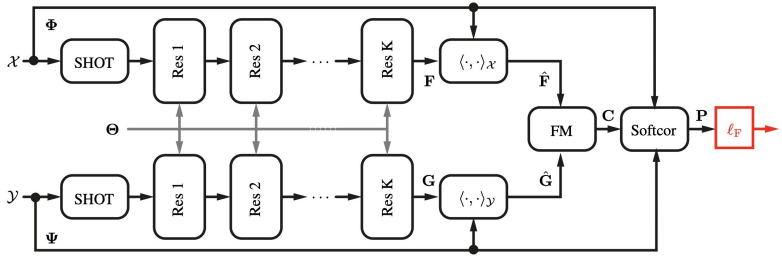


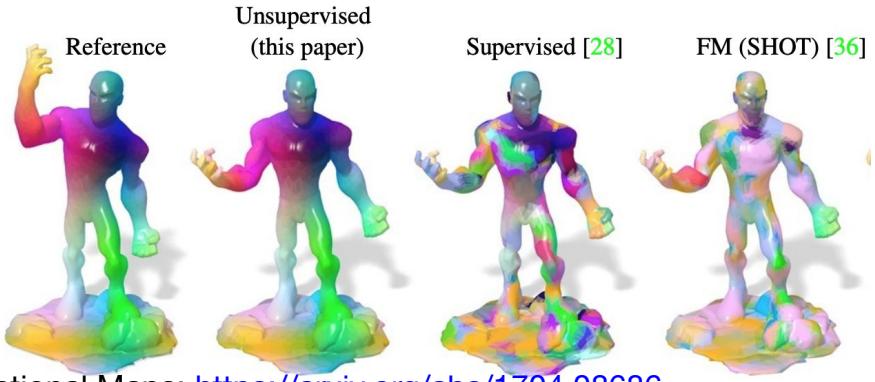


Ovsjanikov et al. Functional Maps: https://people.csail.mit.edu/jsolomon/assets/fmaps.pdf

Projects Samples

- Descriptor learning



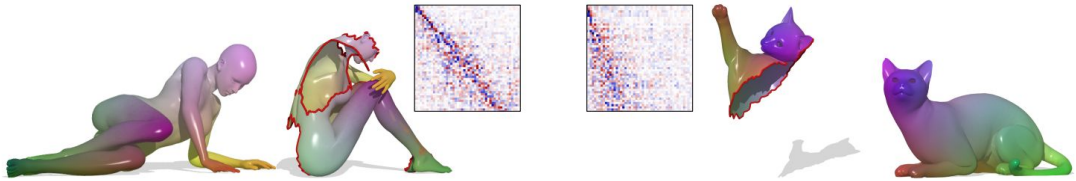


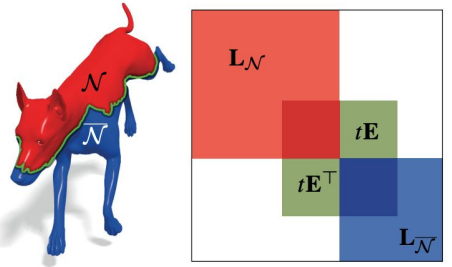
Litany et al. Deep Functional Maps: https://arxiv.org/abs/1704.08686

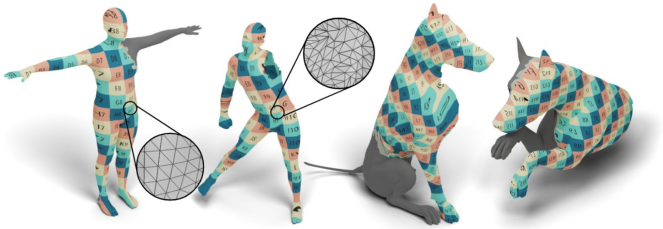
Halimi et al. Unsupervised Learning of Dense Shape Correspondence: https://arxiv.org/abs/1812.02415

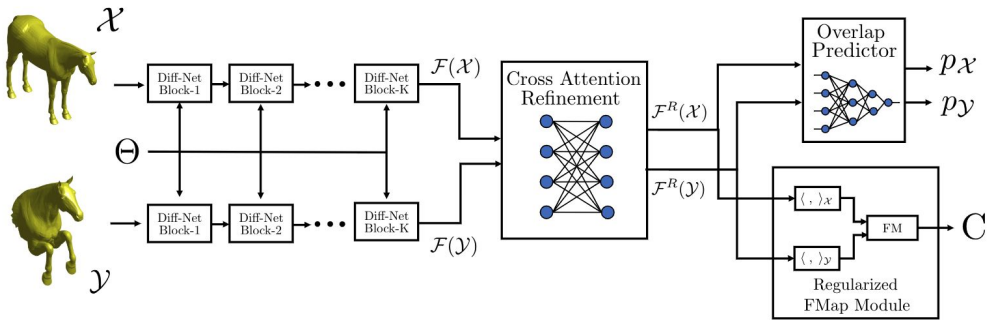
Projects Samples

- Partial shapes correspondences





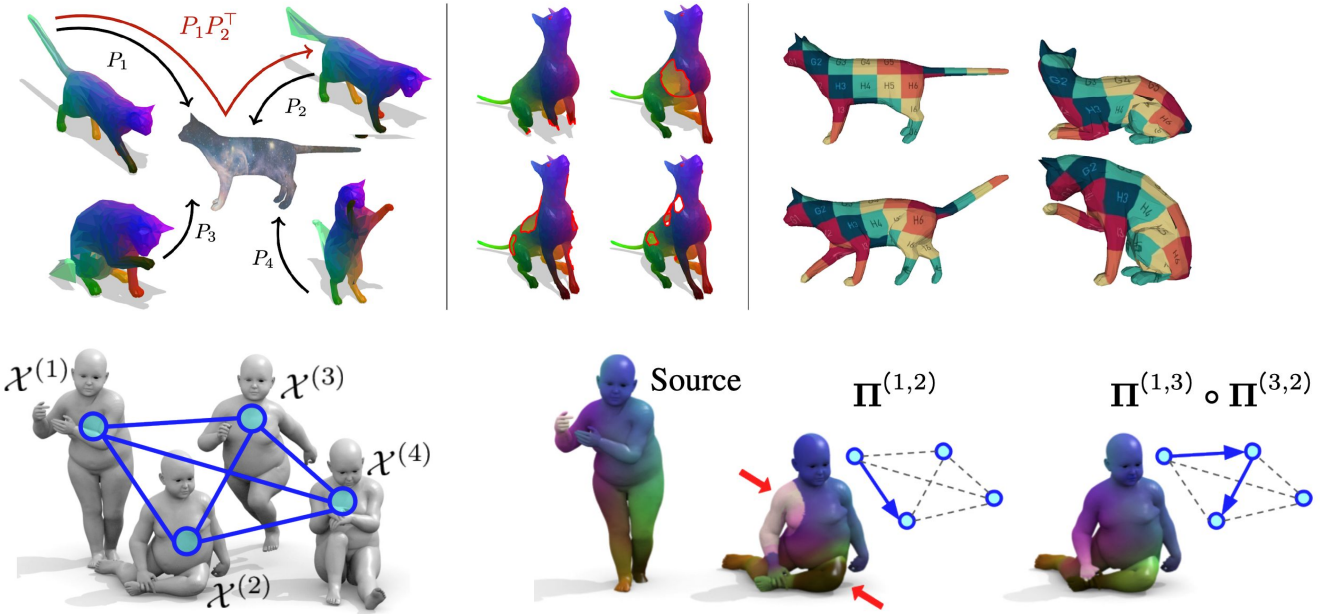




Rodolà et al. Partial Functional Maps: https://vision.in.tum.de/_media/spezial/bib/rodola-partial.pdf
Attaiki et al. Deep Partial Functional Maps: https://arxiv.org/abs/2110.09994

Projects Samples

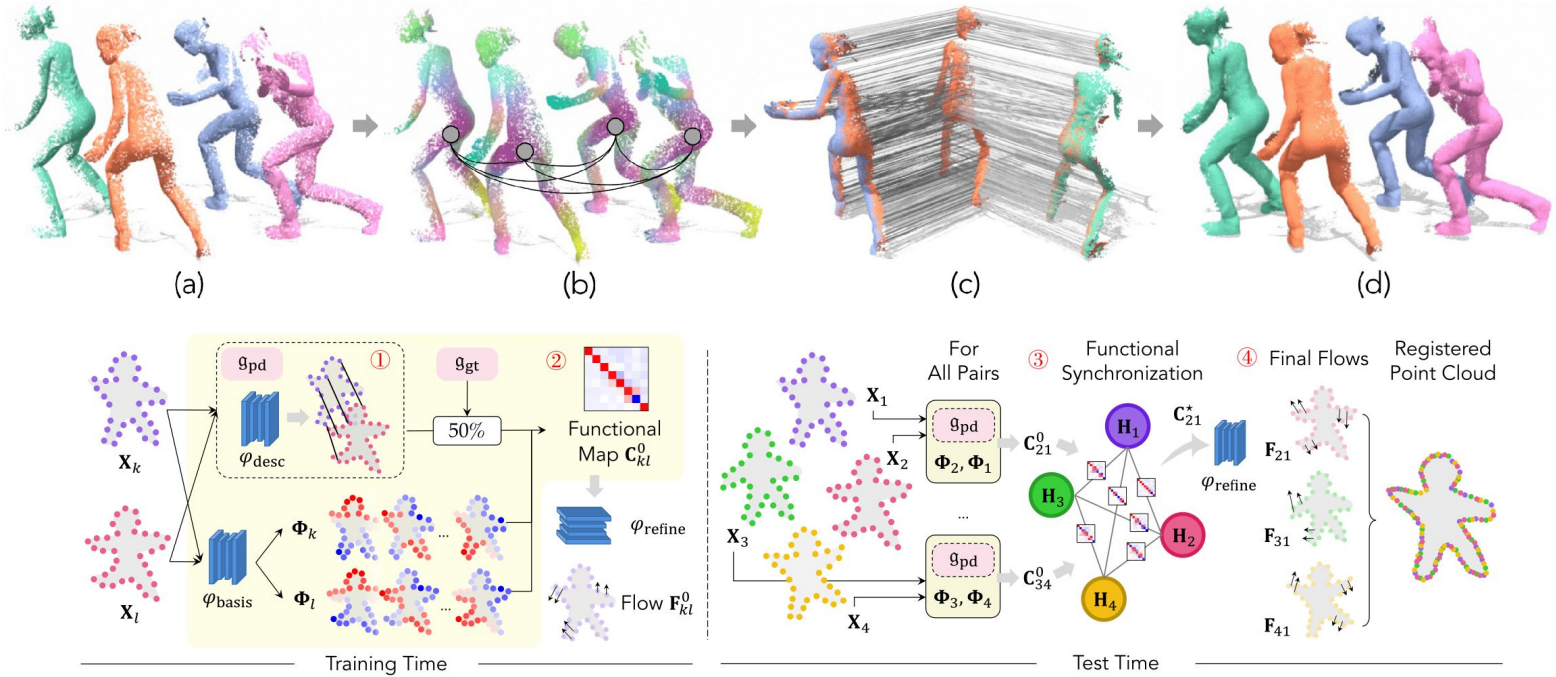
- Correspondences in shape collection



Gao et al. Isometric Multi-Shape Matching: https://arxiv.org/abs/2012.02689
Eisenberger et al. G-MSM: https://arxiv.org/abs/2212.02910

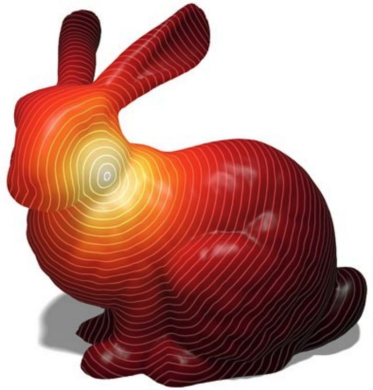
Projects Samples

- Point clouds registration

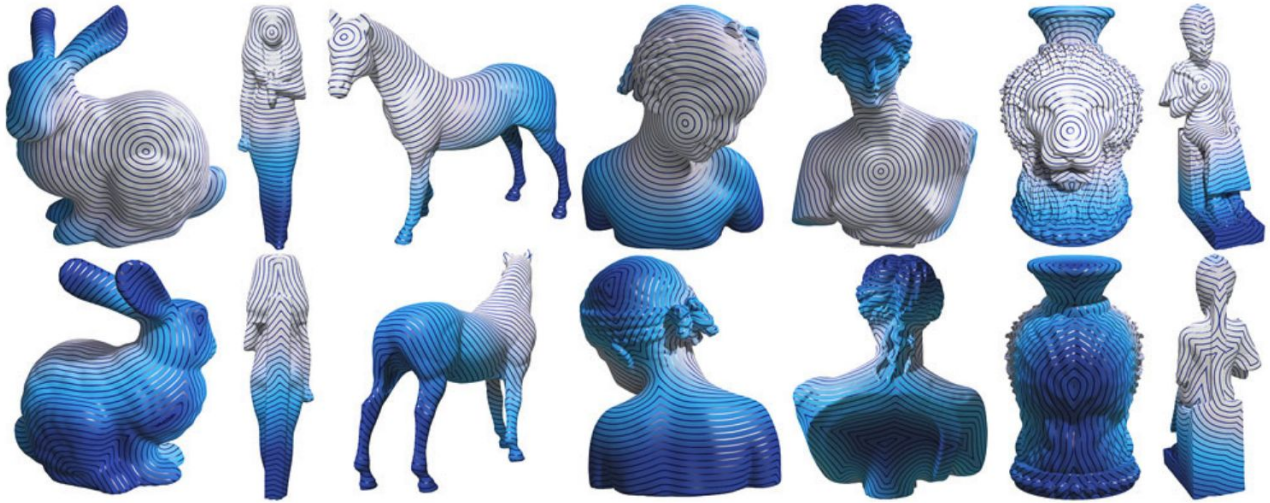


Huang et al. Synorim: https://arxiv.org/abs/2111.12878

Projects Samples



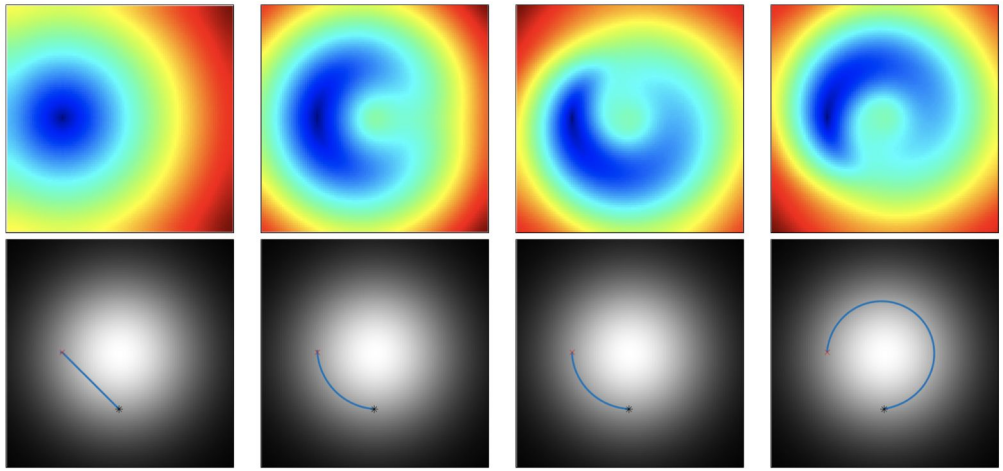
- Geodesic distances computation



Crane et al. Geodesics in Heat: https://arxiv.org/abs/1204.6216

Projects Samples

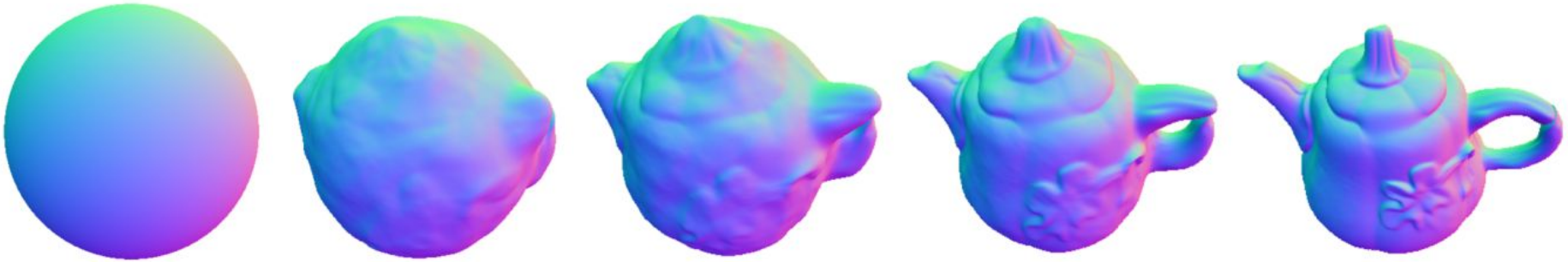
- Asymmetric Geodesic distances computation
- Extension to Finsler manifolds



Yang F. et al., Geodesic via Asymmetric Heat Diffusion Based on Finsler Metric
https://www.ceremade.dauphine.fr/~cohen/mypapers/FangYangACCV18-0788

Projects Samples

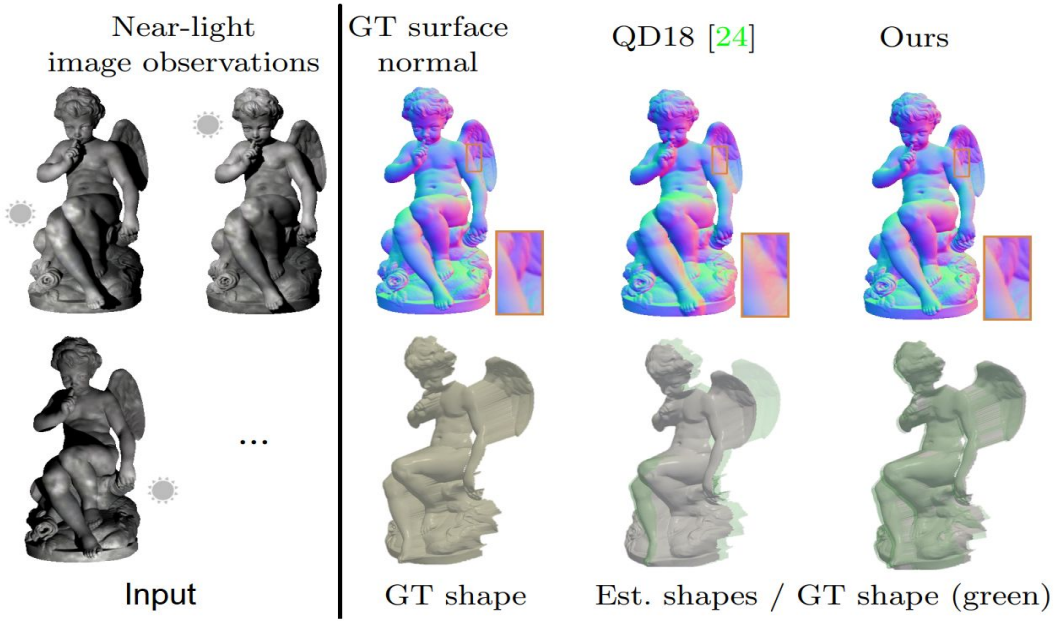
- Shape reconstruction by deforming the unit sphere to the desired shape
- Uses only a set of color images from various viewpoints as input



Cheng et al., “Diffeomorphic Neural Surface Parameterization for 3D and reflectance acquisition”, https://dl.acm.org/doi/10.1145/3528233.3530741

Projects Samples

- Single View 3D reconstruction using a Neural depth map



Guo et al., “Edge-preserving Near-light Photometric Stereo with Neural Surfaces”, https://arxiv.org/abs/2207.04622

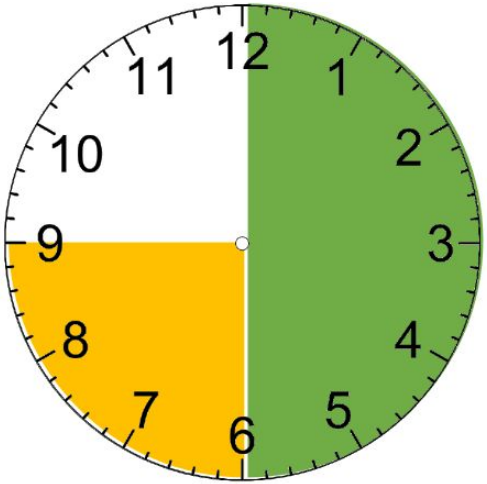
Any Questions?

Website: https://vision.in.tum.de/teaching/ss2023/srmcv

Email: srmcv-ss23@vision.in.tum.de

Appendix

Presentation, Q&A



- 30 minutes talk + Q&A (~15 min)

- number your slides
- use visualizations instead of full text
- reference the original author and conference/journal name
- use your template of choice

Recommended structure

1. Introduction of the problem
2. Approach
3. Results (if any)
4. Summary

Technical Report

- Overview and main contributions of the assigned topic
- The report **is due 1 week after the oral exam**
- Address the open questions left from the Q&A session
- 6-10 pages
- Use CVPR Latex template: http://cvpr2021.thecvf.com/sites/default/files/2020-09/cvpr2021AuthorKit_2.zip
- Use your text editor of choice if you must but keep the style similar to the template